Selection of PM10 and PM2.5 Continuous Monitors for California Ambient Air Quality Standards

California Air Resources Board
Ahmed Mehadi

National Air Quality Conference
February, 2003
San Antonio, TX

Background

- 1987 the State of California adopted the SSI as the State PM sampler
- 2000 CARB staff began to review the existing State PM10 standard, and a proposal for PM2.5, including the monitoring methods

Goals

- Accurate methods for PM measurement
- Finer time resolution
- Essentially “real time” data

Data Use

- Attainment determination
- Trend analyses
- Air quality indexing
- Improved utility for research
  - Understanding nature and extent of PM
  - More comprehensive temporal coverage
  - Others

Evaluation of Continuous Monitors

- Rigorously controlled head-to-head comparison
- October 2001 thru January 2002
- Part of SLAMS network operations

Location of the study

- ARB monitoring station, Bakersfield
- PM is a major issue
- Nearby activities
  - -oil production
  - -agricultural operations
  - -motor vehicle traffic
- Volatile compounds are large component of PM

Atmospheric Conditions

- Winter PM concentrations high due to emissions, topography, and meteorology
- Wide range of meteorological and air quality conditions

Design

- Two monitors of each make and size cut
- Two flow performance audits
- Sampling schedule:
  - 1-in-3: the SSI and the Partisol PM10s, and one of the RAAS PM2.5
  - 24/7: the second RAAS and the continuous monitors

Instruments

Federal Reference Methods

- PM10: SSI and Partisol PM10
- PM2.5: RAAS

Continuous Monitors

- Andersen BAM (FH 62 C14)
- Met One BAM (1020)
- Tapered element oscillating microbalance filter dynamics measurement system (R&P TEOM-FDMS series 8500)
- Continuous ambient mass monitor (CAMM)

Met One BAM 1020

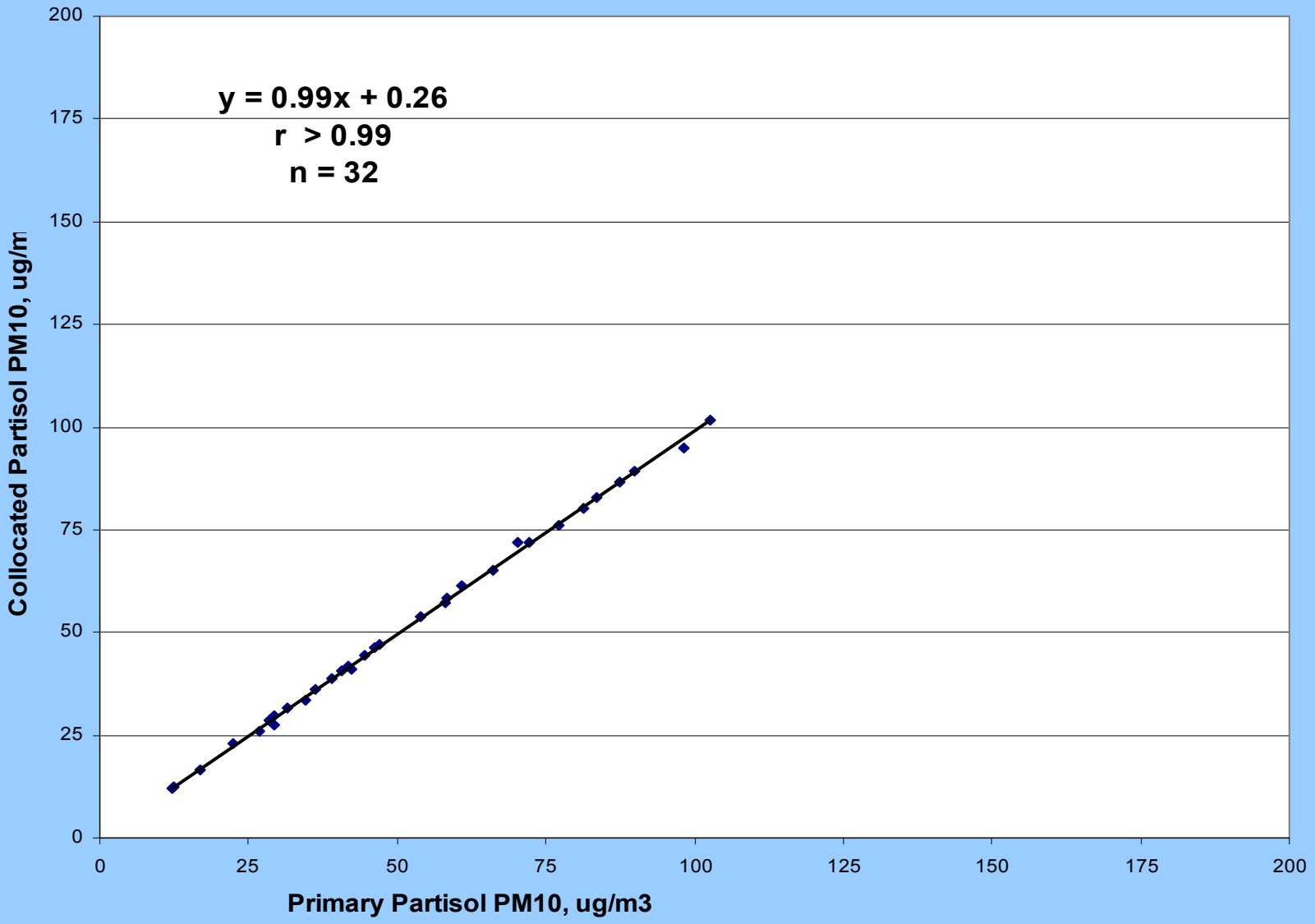
Thermo Andersen BAM FH 62 C14

R&P TEOM-FDMS Series 8500

Bakersfield Sampling Site, Roof-Top

Results

Precision: Primary vs Collocated Partisol PM10



Precision of FRMs

X	Y	Intercept $\mu g/m^3$	slope	r	n
PM10					
Partisol	Partisol	0.26	0.99	>0.99	32
SSI	SSI	0.18	1.01	>0.99	32
PM2.5					
RAAS	RAAS	-0.57	0.98	>0.99	33

Accuracy of PM10 Monitors (24-hr average values)

X	Y	Intercept $\mu g/m^3$	slope	r	n
Partisol	And-BAM	-2.50	1.04	0.99	34
Partisol	Met-BAM	-1.65	1.13	>0.99	31
Partisol	TEOM-FDMS	1.08	1.05	0.97	30

Accuracy of PM2.5 Monitors (24-hr average values)

X	Y	Intercept $\mu g/m^3$	slope	r	n
RAAS	And-BAM	-1.32	1.01	0.98	102
RAAS	Met-BAM	-1.58	1.03	>0.99	102
RAAS	TEOM-FDMS	3.73	1.01	0.99	102
RAAS	CAMM	9.79	0.68	0.87	92

Precision of PM2.5 Monitors (24-hr average)

X	Y	Intercept $\mu g/m^3$	slope	r	n
And-BAM	And-BAM	0.93	0.97	0.98	99
Met-BAM	Met-BAM	-1.19	0.98	>0.99	105
TEOM-FDMS	TEOM-FDMS	0.88	1.04	0.99	50
CAMM	CAMM	2.57	0.97	0.98	95

PM2.5 Inter-Monitor Comparison (24-hr average values)

X	Y	Intercept $\mu g/m^3$	slope	r	n
And-BAM	Met-BAM	1.24	0.98	0.98	94
And-BAM	TEOM-FDMS	5.14	0.99	0.99	96
Met-BAM	TEOM-FDMS	4.54	0.99	>0.99	101
And-BAM	CAMM	13.64	0.60	0.79	91
Met-BAM	CAMM	10.74	0.65	0.87	94
TEOM-FDMS	CAMM	8.77	0.63	0.85	95

Precision of PM2.5 Monitors (one-hour values)

X	Y	Intercept $\mu g/m^3$	slope	r	n
And-BAM	And-BAM	1.35	0.95	0.98	2144
Met-BAM	Met-BAM	-0.31	0.95	0.97	2295
TEOM-FDMS	TEOM-FDMS	2.25	1.0	0.97	1135
CAMM	CAMM	4.41	0.92	0.98	2144

PM2.5 Inter-Monitor Comparison (One-hour values)

X	Y	Intercept $\mu g/m^3$	slope	r	n
And-BAM	Met-BAM	2.38	0.94	0.95	2396
And-BAM	TEOM-FDMS	7.32	0.94	0.95	2396
Met-BAM	TEOM-FDMS	5.84	0.97	0.98	2396
And-BAM	CAMM	14.35	0.61	0.69	2396
Met-BAM	CAMM	13.45	0.63	0.70	2396
TEOM-FDMS	CAMM	10.32	0.63	0.70	2396

Equivalency Specifications for PM10 (40CFR Part 53, Table C-1)

Slope	1 ±0.1
Intercept ($\mu g/m^3$)	0 ±5
Correlation, r	≥0.97

REM*	Bias	±10%
	r	= 0.93
	precision	< 20%CV

*under discussion

Accuracy of PM10 Monitors (24-hr average values)

X	Y	Intercept $\mu g/m^3$	slope	r	n
Partisol	And-BAM	-2.50	1.04	0.99	34
Partisol	Met-BAM	-1.65	1.13	>0.99	31
Partisol	TEOM-FDMS	1.08	1.05	0.97	30

Accuracy of PM2.5 Monitors (24-hr average values)

X	Y	Intercept $\mu g/m^3$	slope	r	n
RAAS	And-BAM	-1.32	1.01	0.98	102
RAAS	Met-BAM	-1.58	1.03	>0.99	102
RAAS	TEOM-FDMS	3.73	1.01	0.99	102
RAAS	CAMM	9.79	0.68	0.87	92

Summary

- The three continuous monitors each with PM10 and PM2.5 inlet met the U.S. EPA PM10 equivalency criteria
  - Andersen BAM (FH 62 C14)
  - Met One BAM (1020)
  - R&P TEOM-FDMS (model 8500)
- CARB approved these monitors with SCC or with VSCC for use to determine compliance with the State ambient AAQSs.